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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/643,062	08/18/2003	John R. Richards	4094-009	4152
24112	7590	09/28/2006	EXAMINER	
COATS & BENNETT, PLLC			WONG, EDNA	
P O BOX 5			ART UNIT	PAPER NUMBER
RALEIGH, NC 27602			1753	

DATE MAILED: 09/28/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/643,062	RICHARDS ET AL.	
	Examiner	Art Unit	
	Edna Wong	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 31 July 2005.
- 2a) This action is FINAL! 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 3,7-9 and 12-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 3,7-9 and 12-23 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) Notice of Informal Patent Application
- 6) Other: _____

This is in response to the Amendment dated July 31, 2006. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Claim Rejections - 35 USC § 112

Claims **6 and 7** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 6 and 7 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 102

Claims **1-3, 7-8 and 10-11** have been rejected under 35 U.S.C. 102(b) as being anticipated by **Stevens** (US Patent No. 4,416,748).

The rejection of claims 1-3, 7-8 and 10-11 under 35 U.S.C. 102(b) as being anticipated by Stevens has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **4, 6 and 9** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Stevens** (US Patent No. 4,416,748) as applied to claims 1-3, 7-8 and

10-11 above.

The rejection of claims 4, 6 and 9 under 35 U.S.C. 103(a) as being unpatentable over Stevens as applied to claims 1-3, 7-8 and 10-11 above has been withdrawn in view of Applicants' amendment.

II. Claims 12-18 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Stevens** (US Patent No. 4,416,748) in combination with **Kupper et al.** (US Patent No. 5,219,544).

The rejection of claims 12-18 under 35 U.S.C. 103(a) as being unpatentable over Stevens in combination with Kupper et al. has been withdrawn in view of Applicants' amendment.

Response to Amendment

Declaration

The declaration under 37 CFR 1.132 filed August 15, 2006 is sufficient to overcome the rejection of claims 3 and 7-9 based upon a specific reference applied under 35 USC 102 and 103.

Claim Objections

Claims 20 and 22 are objected to because of the following informalities:

Claim 20

line 1, the word "including" should be amended to the words -- further comprising
--. See claim 12, line 2.

Claim 22

line 1, the word "including" should be amended to the words -- further comprising
--. See claim 19, line 1.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

I. Claim 23 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 23

lines 1-2, recites "wherein the hydroxyl and hydroperoxy free radical reactions results in the conversion of NO to NO₂". However, Applicants' specification discloses that "these hydroxyl and hydroperoxy radicals react with ammonia to yield the NH₂ radical that reacts further to yield N₂" (page 24, lines 9-13).

II. Claims 3, 7-9, 19 and 22-23 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for irradiating with UV light, does not reasonably provide enablement for irradiating with microwave energy. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Claim 19

line 2, recites "irradiating a gas stream". This step is open to irradiating the gas stream with microwave energy. However, Applicants' specification (page 11, lines 12-22) is only directed to irradiating with UV light.

III. Claims 3, 7-9 and 19-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 7

lines 2-3, "the free radicals" lack antecedent basis.

Claim 8

line 1, is dependent upon a cancelled claim.

Claim 19

line 4, "the concentration" (singular) lacks antecedent basis.

Claim 20

lines 1-2, is a duplicate of claim 13.

IV. Claim 9 is rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The omitted steps are:

the step relating the two-stage irradiation process to the irradiating step recited in claim 19, lines 2-3.

Are there three irradiating steps or is the two-stage irradiation process further limiting the irradiating step recited in claim 19, lines 2-3?

Claim Rejections - 35 USC § 103

I. Claims 12-18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kupper et al. (US Patent No. 5,219,544) in combination with Stevens (US Patent No. 4,416,748).

Kupper teaches a method of producing cement and removing ammonia from a gas stream produced, comprising:

a. directing a raw feed (= a raw material) into a pyroprocessing system of a cement manufacturing facility (= a plant for the production of cement clinker), and heating 1 (= a pre-heater) the raw feed as the raw feed moves through the pyroprocessing system;

b. directing the heated raw feed through at least one kiln 2 (= a rotary kiln) that forms a part of the pyroprocessing system to produce cement clinker; and

c. heating the pyroprocessing system (= the rotary kiln 2 is heated in the usual way from the material discharge side (arrow 6)) and directing the resulting gas stream through the pyroprocessing system (= the exhaust gases from the rotary kiln 2 pass through the pre-heater and then pass either to a cooling tower 7 or to a raw grinding mill 8 which serves for drying and grinding the raw material and then pass into the next filter 10) [col. 5, line 45 to col. 6, line 6; and Fig. 1].

The method further comprises removing particulate matter from the gas stream prior to the gas stream being subjected to irradiation to form free radicals that react with the ammonia (= after passing through the cooling tower 7 or the raw grinding mill 8 the exhaust gases are cleaned of dust, e.g., in an electrostatic filter 9 and then pass into the next filter 10) [col. 8, lines 62-65].

The method further comprises filtering particulate matter from the gas stream (= after passing through the cooling tower 7 or the raw grinding mill 8 the exhaust gases are cleaned of dust, e.g., in an electrostatic filter 9 and then pass into the next filter 10) [col. 8, lines 62-65].

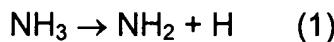
The method of Kupper differs from the instant invention because Kupper does not disclose the following:

- a. Irradiating the gas stream with UV light and disassociating hydrogen

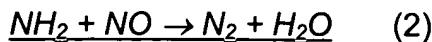
atoms from ammonia within the gas stream to form NH₂, and reacting the NH₂ with NO_x to form N₂ and H₂O.

Kupper teaches adsorbing NH_x compounds by passing exhaust gases from the preheating zone through a filter having an adsorption stage containing an adsorbent capable of adsorbing NH_x compounds; and periodically delivering at least a portion of used NH_x-containing adsorbent from said adsorption stage into at least one of said zones thereby releasing the NH_x compounds contained in the adsorbent for reaction with the exhaust gases and reducing a portion of the NO_x compounds present in such exhaust gases prior to passing such gases to said adsorption stage (col. 6, claim 1).

Like Kupper, Stevens teaches a process for the reduction of the content of SO₂ and/or the nitrogen oxides NO and NO₂ in flue gases (col. 1, lines 5-8). Stevens teaches that it has been proposed to remove NOx from flue gases by mixing the gas with NH₃ and irradiating the mixture with ultraviolet light. By this process, the NH₃ is photolysed to yield amino radical (NH₂) in accordance with the equation



The amino radical reacts with NO₂ to yield the inert gas nitrogen and N₂O which is widely regarded as being inert and harmless in the atmosphere, in accordance with the equations



It has now been found that increased efficiency of the utilization of the ultraviolet

light can be obtained when ultraviolet light of a wavelength falling within a selected range is employed. More specifically, the present invention provides, in one aspect, a process for reduction of the content of NO and NO₂ in flue gas, said flue gas containing also substantial quantities of H₂O vapor, comprising mixing the flue gas with NH₃ and irradiating the mixture with ultraviolet radiation of wavelength about 190 to about 220 nm.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the absorbing and releasing of the NH_x compounds in the adsorbent for reaction with the exhaust gases described by Kupper by irradiating the gas stream with UV light and disassociating hydrogen atoms from ammonia within the gas stream to form NH₂, and reacting the NH₂ with NO_x to form N₂ and H₂O because Stevens teaches an art recognized equivalent for the same purpose as Kupper, i.e., reacting NH_x + NO_x. An expressed suggestion to substitute one equivalent component or process for another is not necessary to render such substitution obvious. *In re Fout*, 675 F.2d 297, 213 USPQ 532 (CCPA 1982) and MPEP 2144.06.

- b. Wherein the method further comprises irradiating the gas stream with UV light in the spectral range of 230 to 370 nanometers, as recited in claim 13.
- c. Wherein the method includes irradiating the gas stream with UV light in the spectral range of 230-370 nanometers, as recited in claim 20.

Stevens teaches that the radiation is provided from a high pressure short arc mercury-xenon lamp providing a continuous spectrum output from 190 nm to above 300 nm (col. 10, claim 2).

d. Wherein the intensity of the irradiation falls in the range of 100-2000 microwatts per square centimeter, as recited in claim 15.

Stevens teaches that the gaseous mixture is subjected to a total quantity of radiant energy flux of radiation in said wavelength range of from about 10^{18} to 10^{19} photon/cm² of the irradiated area (col. 10, claim 4).

e. Wherein the method further comprises providing a two-stage irradiation process where one irradiation stage is employed prior to filtering the particulate matter and the second irradiation stage is employed after filtering the particulate matter, as recited in claim 16.

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Stevens because the repetition of steps to provide the same results is well within the skill of one having ordinary skill in the art. The concept of duplication is not patentable. *St. Regis Paper Co. v. Bemis Co. Inc.*, 193 USPQ 8, 11 (7th Cir. 1977). While this decision relates to the duplication of parts, there is no reason why such duplication cannot be extended to a process step.

Furthermore, Stevens teaches one irradiation stage employed prior to filtering the particulate matter (Fig. 1a) and one irradiation stage employed after filtering the particulate matter (Fig. 1).

f. Wherein the disassociated hydrogen atoms form hydroperoxy free radicals that continue to initiate oxidation reactions with the ammonia, as recited in claim 17.

Stevens teaches chemical reactions that occur during photolysis (cols. 8-9, Table 3). Reaction 20 is $H + O_2 \rightarrow HO_2$ and Reaction 10 is $NH_2 + HO_2 \rightarrow HNO + H_2O$.

g. Wherein the disassociated hydrogen atoms form H_2O and hydroperoxy free radicals and wherein the hydroperoxy free radicals continue to initiate oxidation reactions with the ammonia, as recited in claim 18.

Stevens teaches chemical reactions that occur during photolysis (cols. 8-9, Table 3). Reaction 46 is $OH + H \rightarrow H_2O$, Reaction 20 is $H + O_2 \rightarrow HO_2$, and Reaction 10 is $NH_2 + HO_2 \rightarrow HNO + H_2O$.

II. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Kupper et al.** (US Patent No. 5,219,544) in combination with **Stevens** (US Patent No. 4,416,748) as applied to claims 12-18 and 20 above, and further in view of Applicants' Admitted Prior Art (Specification, page 2, line 12 to page 3, line 5).

Kupper and Stevens are as applied above and incorporated herein.

The method of Kupper differs from the instant invention because Kupper does not disclose wherein the ammonia is present in the gas stream at concentrations less than 40 ppm, and wherein irradiating the gas stream with UV light in the spectral range of 230-370 nanometers causes the photolysis of nitrogen dioxide, ozone and hydrogen peroxide present and/or formed in the gas stream, and wherein the photolysis of nitrogen dioxide, ozone and hydrogen peroxide initiates a set of hydroxyl and hydroperoxy free radical reactions that result in the removal of a hydrogen atom from ammonia to form an NH₂ radical, as recited in claim 21.

Kupper teaches exhaust gases from a cement kiln.

Trace quantities of NH₃ would have been present in the exhaust gases probably from the result from the pyrolysis of nitrogenous compounds in the raw materials. If NH₃ were used as a reagent in a NO_x control technology, unreacted NH₃ could result in "ammonia slip" that would contribute to regional haze and/or detached plume.

Applicants disclose that ammonia gas in ammonia slip is usually in the range of 2 ppm to 40 ppm (specification, page 2, lines 20-22).

Stevens teaches that the radiation is provided from a high pressure short arc mercury-xenon lamp providing a continuous spectrum output from 190 nm to above 300 nm (col. 10, claim 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the irradiating of the gas stream with UV light described by Stevens with wherein irradiating the gas stream with UV light in the

spectral range of 230-370 nanometers causes the photolysis of nitrogen dioxide, ozone and hydrogen peroxide present and/or formed in the gas stream, and wherein the photolysis of nitrogen dioxide, ozone and hydrogen peroxide initiates a set of hydroxyl and hydroperoxy free radical reactions that result in the removal of a hydrogen atom from ammonia to form an NH₂ radical because Stevens teaches chemical reactions that occur during photolysis (cols. 8-9, Table 3). Stevens teaches photolysis reactions comprising nitrogen dioxide, ozone and hydrogen peroxide. Thus, similar processes can reasonably be expected to yield products (and reactions) which inherently have the same properties. *In re Spada* 15 USPQ 2d 1655 (CAFC 1990); *In re DeBlauwe* 222 USPQ 191; *In re Wiegand* 86 USPQ 155 (CCPA 1995).

Allowable Subject Matter

The following is a statement of reasons for the indication of allowable subject matter:

Claims 3, 7-9, 19 and 22-23 define over the prior art of record because the prior art does not teach or suggest a method of removing ammonia from an effluent gas stream comprising the steps of (a) irradiating, (b) substantially reducing, (c) initiating and (d) maintaining as presently claimed. The prior art does not contain any language that teaches or suggests the above. Therefore, a person skilled in the art would not have been motivated to adopt the above conditions, and a *prima facie* case of obviousness cannot be established.

Claims 3, 7-9, 19 and 22-23 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 1st and/or 2nd paragraphs, set forth in this Office action.

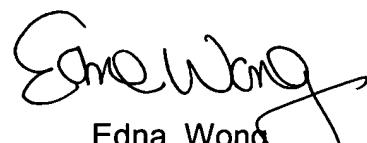
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Edna Wong
Primary Examiner
Art Unit 1753

EW
September 25, 2006